

U.S. Patent Application Serial No. 10/665,259  
Amendment filed March 15, 2006  
Reply to OA dated November 25, 2005

**AMENDMENTS TO THE CLAIMS:**

Please amend claims 1, 17, 19 and 31, as follows. This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

Claim 1 (Currently amended): A semiconductor light-receiving device comprising:

- a substrate that has a first surface and a second surface ~~facing~~ opposite to each other;
- a first semiconductor layer that is formed ~~on~~ above the first surface of the substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed ~~on~~ above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed ~~on~~ above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that is electrically connected to the first semiconductor layer and applies a first potential thereto;
- a second electrode part that is electrically connected to the second semiconductor layer and applies a second potential thereto; ~~and~~
- a third semiconductor layer of the second conductivity type ~~that is interposed between the first surface of~~ provided so that the substrate, the third semiconductor layer and the first semiconductor layer are arranged in this order; and

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a third electrode part that is electrically connected to the substrate and applies a third potential thereto.

the first potential being higher than the third potential.

Claim 2 (Original): The semiconductor light-receiving device as claimed in claim 1, further comprising a capacitor that includes a p-n junction between the first semiconductor layer and the third semiconductor layer.

Claim 3 (Original): The semiconductor light-receiving device as claimed in claim 2, wherein the capacitor has a depletion-layer region that is formed at the p-n junction between the first semiconductor layer and the third semiconductor layer.

Claim 4 (Original): The semiconductor light-receiving device as claimed in claim 1, further comprising

a fourth semiconductor layer of the first conductivity type,

wherein the third semiconductor layer is interposed between the first semiconductor layer and the fourth semiconductor layer.

Claim 5 (Original): The semiconductor light-receiving device as claimed in claim 2, wherein the capacitor functions as a bypass capacitor that bypasses current flowing between the first

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semiconductor layer and the second semiconductor layer when carriers are generated in the light absorption layer.

Claim 6 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the first semiconductor layer includes a contact layer that is connected to the first electrode part and has a relatively high impurity concentration.

Claim 7 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the second semiconductor layer includes a contact layer that is connected to the second electrode part and has a relatively high impurity concentration.

Claim 8 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 9 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

Claim 10 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein:

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at least the light absorption layer and the second semiconductor layer form a mesa structure; and  
light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 11 (Original): The semiconductor light-receiving device as claimed in claim 10,  
further comprising an optical waveguide path that is provided on a side of the mesa structure and  
guides light into the light absorption layer.

Claim 12 (Original): The semiconductor light-receiving device as claimed in claim 10,  
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;  
the first electrode part is formed on the exposed surface; and  
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 13 (Original): The semiconductor light-receiving device as claimed in claim 1,  
comprising an avalanche diode.

Claim 14 (Original): The semiconductor light-receiving device as claimed in claim 1,  
wherein:

the first semiconductor layer includes an n-type InP layer; and  
the second semiconductor layer includes a p-type InP layer.

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Claim 15 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the light absorption layer is an InGaAs layer.

Claim 16 (Original): The semiconductor light-receiving device as claimed in claim 1, wherein the third semiconductor layer is a p-type InP layer and has an impurity concentration of  $1 \times 10^{16} \text{ cm}^{-3}$  or lower.

Claim 17 (Currently amended): A semiconductor light-receiving device comprising:

- a semiconductor substrate that has a first surface and a second surface facing opposite to each other;
- a first semiconductor layer that is formed ~~on~~ above the first surface of the semiconductor substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed ~~on~~ above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed ~~on~~ above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that is electrically connected to the first semiconductor layer and applies a first potential thereto;
- a second electrode part that is electrically connected to the second semiconductor layer and

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applies a second potential thereto; and

a capacitive element that comprises a dielectric material ~~interposed between~~ provided so that  
the first surface of the semiconductor substrate, the dielectric material and the first semiconductor  
layer are arranged in this order.

Claim 18 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein the capacitive element includes a high-resistance semiconductor layer that is interposed  
between a pair of semiconductor layers of the first conductivity type.

Claim 19 (Currently amended): The semiconductor light-receiving device as claimed in  
claim ~~5~~ 17, wherein ~~the same~~ a third potential ~~as~~ equal to the second potential is supplied to the  
second surface of the substrate.

Claim 20 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein the first semiconductor layer includes a contact layer that is connected to the first electrode  
part and has a relatively high impurity concentration.

Claim 21 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein the second semiconductor layer includes a contact layer that is connected to the second  
electrode part and has a relatively high impurity concentration.

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Claim 22 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 23 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

Claim 24 (Original): The semiconductor light-receiving device as claimed in claim 17, wherein:

at least the light absorption layer and the second semiconductor layer form a mesa structure;

and

light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 25 (Original): The semiconductor light-receiving device as claimed in claim 24, further comprising an optical waveguide path that is provided on a side of the mesa structure and guides light into the light absorption layer.

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Claim 26 (Original): The semiconductor light-receiving device as claimed in claim 24,  
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;  
the first electrode part is formed on the exposed surface; and  
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 27 (Original): The semiconductor light-receiving device as claimed in claim 17,  
comprising an avalanche diode.

Claim 28 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein:

the first semiconductor layer includes an n-type InP layer; and  
the second semiconductor layer includes a p-type InP layer.

Claim 29 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein the light absorption layer is an InGaAs layer.

Claim 30 (Original): The semiconductor light-receiving device as claimed in claim 17,  
wherein the capacitive element functions as a bypass capacitor that bypasses current flowing between



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the first semiconductor layer and the second semiconductor layer when carriers are generated in the light absorption layer.

Claim 31 (Currently amended): A semiconductor light-receiving device comprising:

- a substrate that has a first surface and a second surface facing opposite to each other;
- a first semiconductor layer that is formed on above the first surface of the substrate and includes at least one semiconductor layer portion of a first conductivity type;
- a light absorption layer that is formed on above the first semiconductor layer and generates carriers in accordance with incident light;
- a second semiconductor layer that is formed on above the light absorption layer and includes at least one semiconductor layer portion of a second conductivity type;
- a first electrode part that applies a first potential to the first semiconductor layer, wherein the first potential is higher than the reference potential;
- a second electrode part that applies a second potential to the second semiconductor layer;
- a metal layer that is formed on the second surface of the substrate and has a reference potential supplied thereto; and
- a dielectric layer ~~that is interposed between~~ provided so that the metal layer, the dielectric layer and the second surface of the substrate are arranged in this order,
- a capacitor including dielectric layer being formed in the semiconductor light-receiving device.

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Claim 32 (Original): The semiconductor light-receiving device as claimed in claim 31, comprising a module onto which the substrate is mounted, wherein the metal layer is electrically connected to the module and is supplied with the reference potential.

Claim 33 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the first semiconductor layer includes a contact layer that is connected to the first electrode part and has a relatively high impurity concentration.

Claim 34 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the second semiconductor layer includes a contact layer that is connected to the second electrode part and has a relatively high impurity concentration.

Claim 35 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the first semiconductor layer includes a buffer layer having a relatively low impurity concentration.

Claim 36 (Original): The semiconductor light-receiving device as claimed in claim 31, wherein the second semiconductor layer includes a graded layer in which a plurality of semiconductor layers are stacked so that forbidden bandwidths vary smoothly.

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Claim 37 (Original): The semiconductor light-receiving device as claimed in claim 31,  
wherein:

at least the light absorption layer and the second semiconductor layer form a mesa structure;  
and  
light enters through a side surface of the light absorption layer that is exposed in the mesa structure.

Claim 38 (Original): The semiconductor light-receiving device as claimed in claim 37,  
further comprising an optical waveguide path that is provided on a side of the mesa structure and  
guides light into the light absorption layer.

Claim 39 (Original): The semiconductor light-receiving device as claimed in claim 37,  
wherein:

the first semiconductor layer has a surface exposed at the bottom of the mesa structure;  
the first electrode part is formed on the exposed surface; and  
the second electrode part is formed on the second semiconductor layer of the mesa structure.

Claim 40 (Original): The semiconductor light-receiving device as claimed in claim 31,  
comprising an avalanche diode.

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Claim 41 (Original): The semiconductor light-receiving device as claimed in claim 31,  
wherein:

the first semiconductor layer includes an n-type InP layer; and

the second semiconductor layer includes a p-type InP layer.

Claim 42 (Original): The semiconductor light-receiving device as claimed in claim 31,  
wherein the light absorption layer is an InGaAs layer.